

**IH-635 (LBJ Freeway)  
Geotechnical Workshop  
West Section Improvements**


Presented By:


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**Hugh T. Kelly, P.E.** - Fugro Consultants LP


**Dave Chapman** - LBJMP Procurement Engineers

December 8, 2004





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## Topics

1. Introduction & Purpose - Matt MacGregor
2. Project Overview - Matt MacGregor
3. Description of Phase I Geotech work - Hugh Kelly
4. Description of Phase II Geotech work - Hugh Kelly
5. GBR Discussion - Dave Chapman
6. Project Schedule - Matt MacGregor
7. Phase III Geotechnical opportunities - Matt MacGregor
8. Questions - Matt MacGregor


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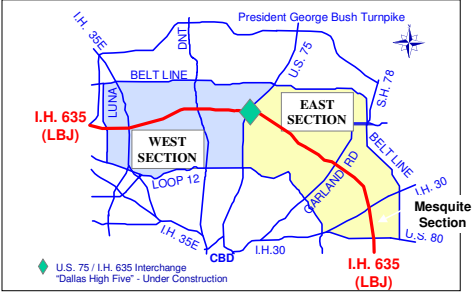
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## Project Description

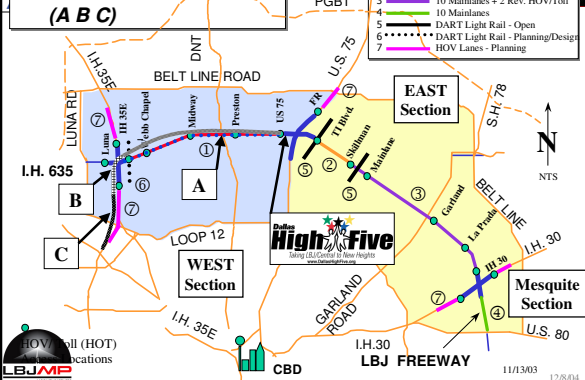




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## LBJ Freeway Corridor West Section CDA Project (A B C)




11/13/03 12/8/04



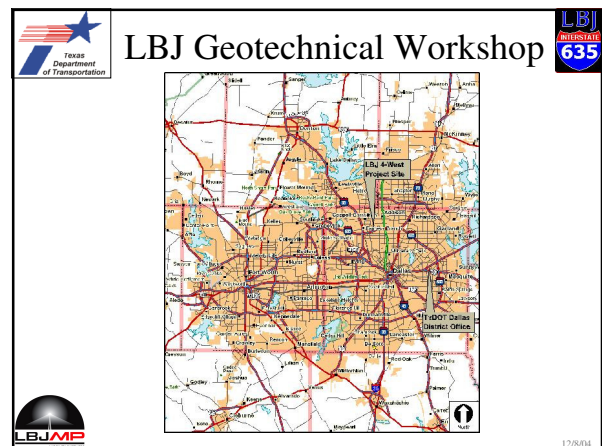
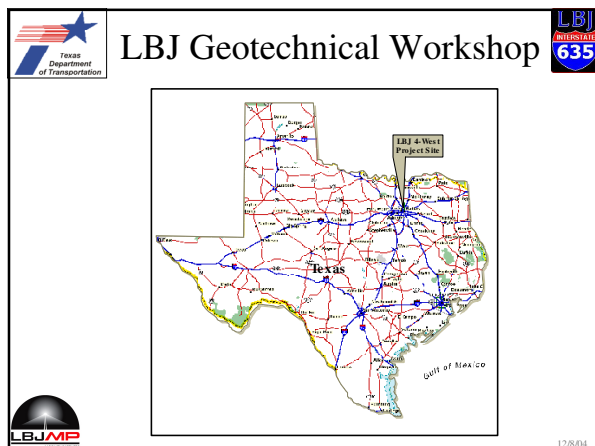
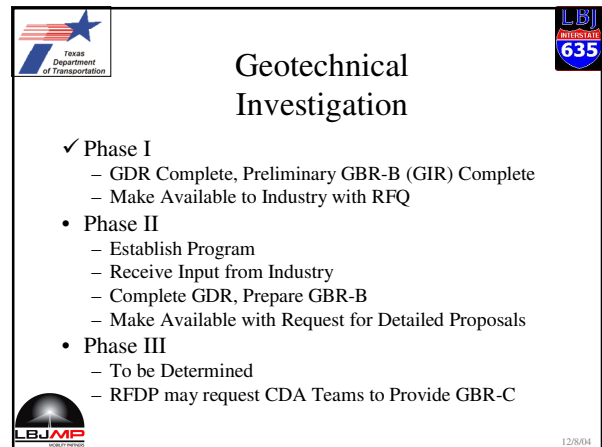
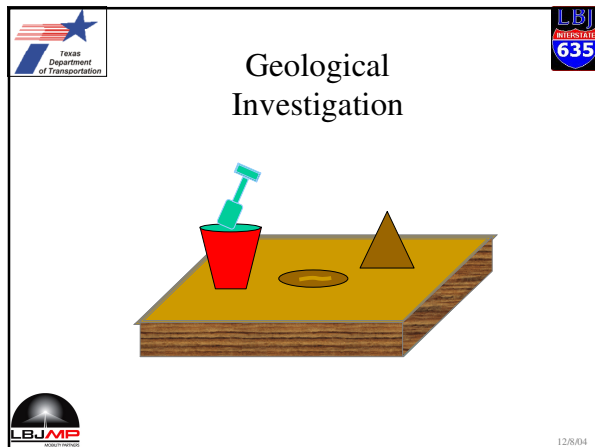
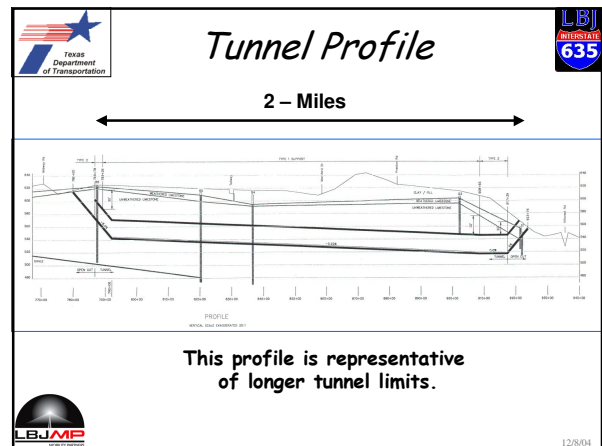
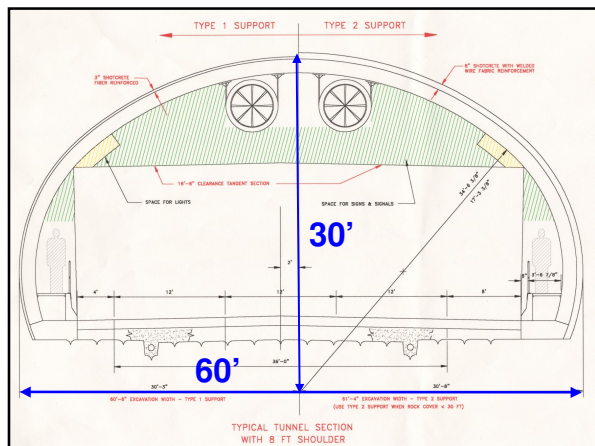


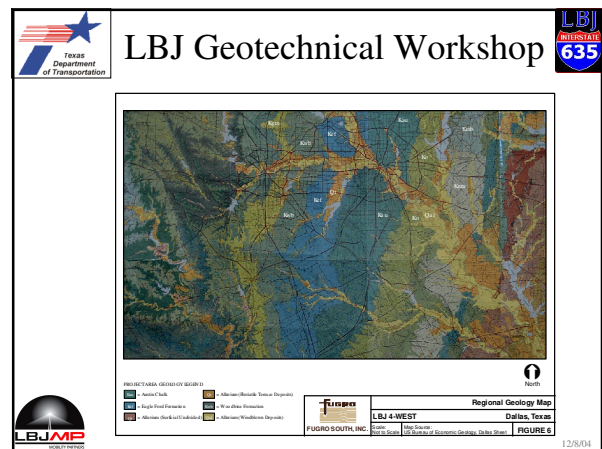
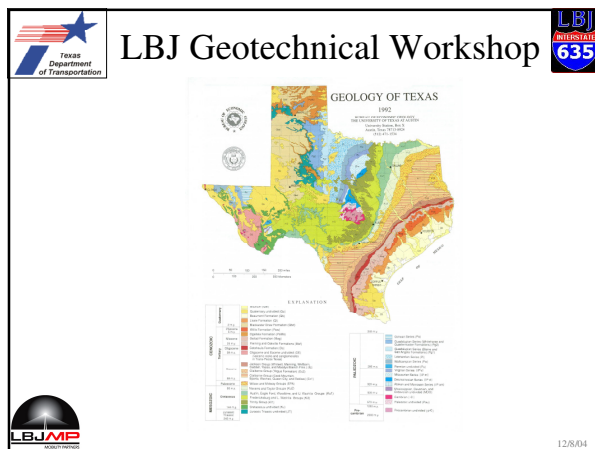
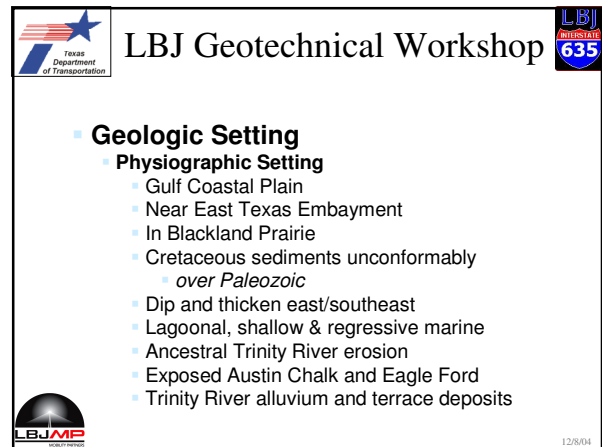
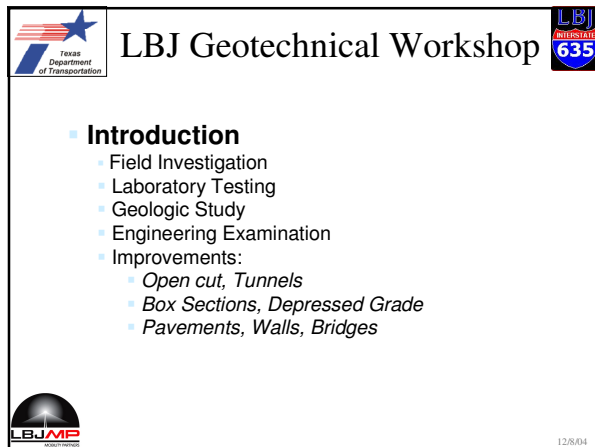
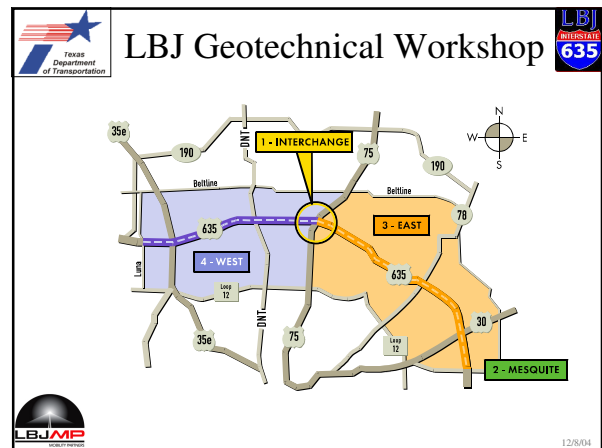
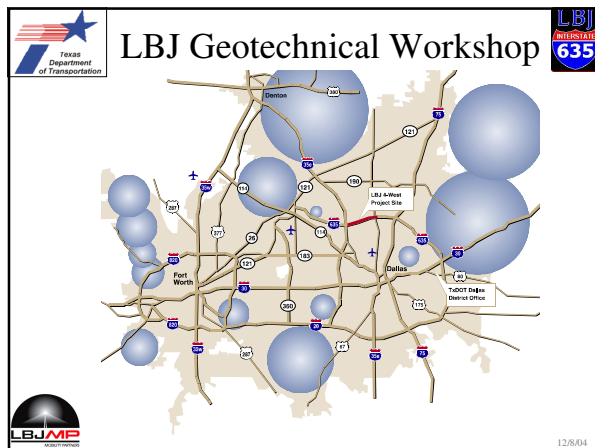
## Managed HOV Tunnels

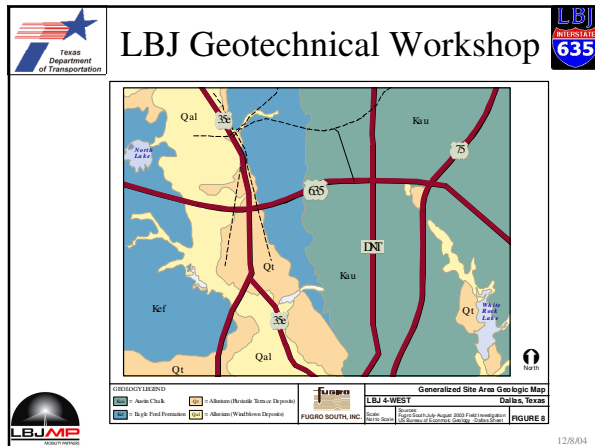
- Shifted south
- "Longest, Widest, Mined Auto Tunnels in U.S."
- Basic dimensions - 2 mile long - 30' x 60' wide




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**LBJ Geotechnical Workshop**

- Region & Alignment Geology**
  - Historical**
    - 1 to 1.5 billion years
    - Major structure Paleozoic
    - Mesozoic activity from current
    - Late Cretaceous deeper seas
    - Cenozoic mostly erosional
  - Seismicity (earthquakes)**
    - More than 100 since mid 1800's
    - Four w/ magnitudes between 5 & 6

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**LBJ Geotechnical Workshop**

- Region & Alignment Geology**
  - Structure**
    - Surface structure Cretaceous
    - Contacts largely parallel
    - Primary structure before lithification
    - Ex: bedding & volcanic ash (bentonite)
    - Only major regional structure
      - Balcones Fault Zone
    - Jointing common
      - High frequency limited to fault zones

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**LBJ Geotechnical Workshop**

- Region & Alignment Geology**
  - Ground Water**
    - No regional aquifers
    - Most likely source – alluvial / terrace
    - Fracture flow – weathered limestone
    - Woodbine Aquifer below (200-300 ft)

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**LBJ Geotechnical Workshop**

- Region & Alignment Geology**
  - Fill
  - Alluvial & Terrace deposits
  - Residual Soils
  - Austin Chalk limestone
  - Eagle Ford shale

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**LBJ Geotechnical Workshop**

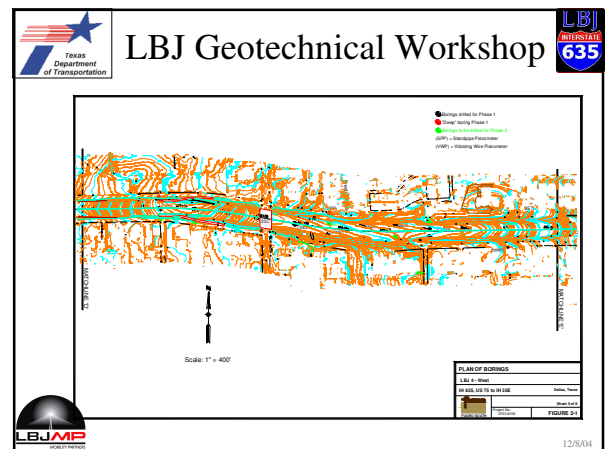
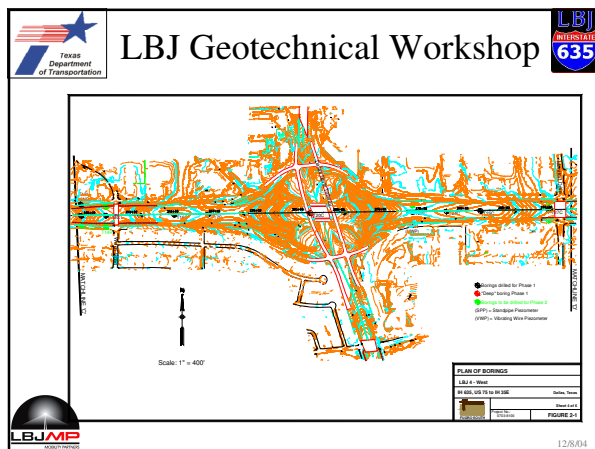
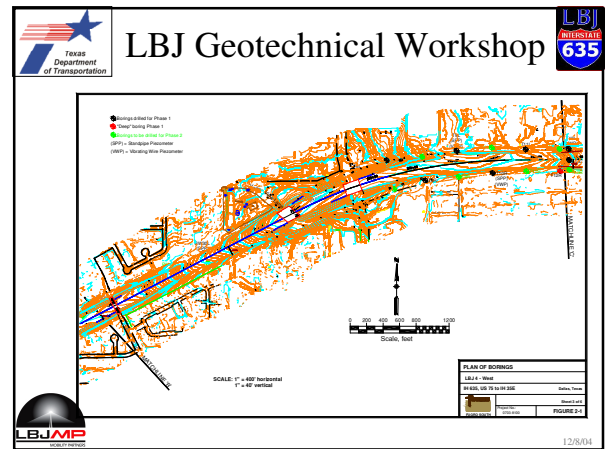
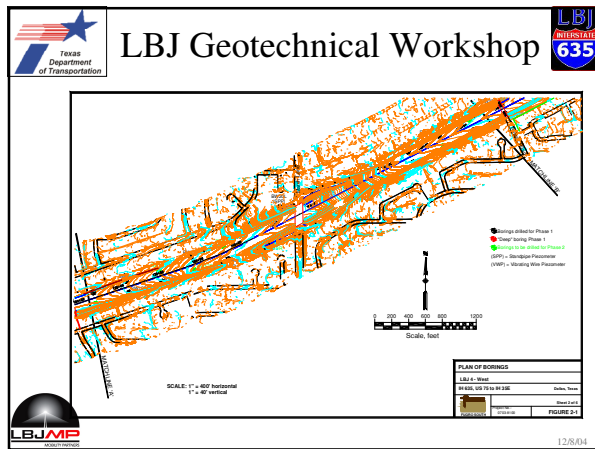
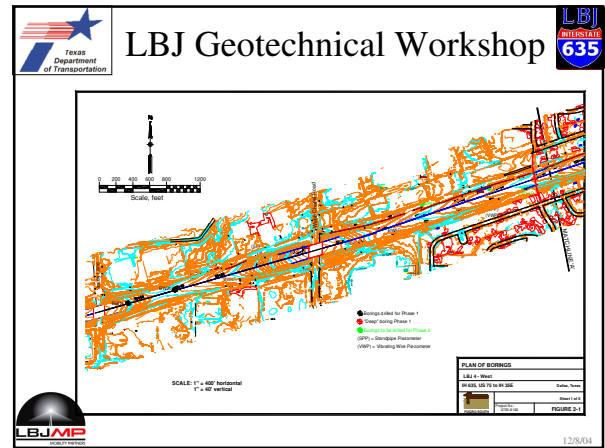
- Subsurface Investigations**
  - 1998 – 14 borings : Improvement planning
  - Current investigation in two phases
  - Phase 1 – 93 borings
    - July-October 2003
    - 45 ft to 135 ft
    - Five at 156 ft to 226 ft
    - Packer tests
    - Standpipe and vibrating Wire Piezometers
    - TCP Testing – 170lb hammer/24" drop

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# LBJ Geotechnical Workshop

BORING NO.	NORTHING	EASTING	SURFACE ELEVATION (FT)	HAULER DRILLED DEPTH (FEET)	ROCK CORE DEPTH (FEET)	TOTAL DEPTH OF BORING (FEET)	HAULER TEST DEPTH (FEET)	STANDARD PENETRATION TEST DEPTH (FEET)	STANDARD PENETRATION TEST DEPTH (FEET)	NO. OF SPT BLOWS	NO. OF TEST TUBES	NO. OF CORE TUBES	WATER BEARING RATIO (COEFFICIENT)
T-1 R	247433.8	247318.0	605.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	11
T-1 L	247433.0	247318.0	607.0	0.18	18.55	35				2	0	3	5
T-1 R	247445.0	247337.0	606.0	0.20	20.55	35				4	0	4	7
T-2 L	247465.0	247359.0	612.0	0.19	18.80	35				2	0	2	16
T-3 R	247465.0	247359.0	607.0	0.19	18.50	35				3	0	3	5
T-3 L	247465.0	247359.0	606.0	0.15	18.80	35				2	0	2	5
T-10 R	247478.5	248041.0	622.0	0.05	8.5	70	35	35	55	65	1	0	7
T-11 L	247467.0	248041.0	625.0	0.0	0.0	0.0							
T-12 R	247478.0	248105.0	630.0	0.11	11.106	126				2	0	1	28
T-12 L	247469.0	248118.0	627.0	0.0	0.0	0.0				3	0	0	34
T-13 L	247458.0	248120.0	622.0	0.10	10.181	121				1	1	0	12
T-14 R	247461.0	248124.0	618.0	0.0	0.0	0.0				0	0	0	19
T-15 R	247465.0	248124.0	617.0	0.0	0.0	0.0				1	0	0	22
T-16 R	247465.0	248124.0	627.0	0.11	11.116	116				0	0	0	27
T-17 R	247465.0	248124.0	618.0	0.15	15.106	106				3	0	0	18


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**LBJ Geotechnical Workshop**




**Laboratory Testing**

- Soil**
  - Water content & Unit weight
  - 83 - Plasticity
  - 6 - Grain size
  - 57 - Unconfined compression
  - 8 - CU Triaxial
  - 9 - UU Triaxial


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**LBJ Geotechnical Workshop**




SUMMARY OF LABORATORY SOIL TESTING RESULTS - RESIDUAL SOIL, PHASE 1  
 I-35 LBJ FREEWAY - WEST SECTION  
 MANAGED HOV LANES TUNNEL PROJECT  
 DALLAS, TEXAS

Boring	Depth (ft)	Geology	Moisture Content (%)	LL	PL	PI	Unit Dry Weight (pcf)	Unconfined Compression (psi)	Unconsolidated Undrained		Percent Swell
									Confining Pressure (psi)	Failure Stress (psi)	
SWL 1	1	Residual EFS	19				110		15	24	
SWL 1	14	Residual EFS	23								
SWL 1R	24	Residual AC	24	64	24	20					
SWL 1R	24	Residual AC	21				89	38			
SWL 4	5	Residual EFS	31	72	23	50	94	19			6.4
SWL 4	4	Residual EFS						15			
SWL 6	6	Residual EFS	29								
SWL 6	10	Residual EFS	29	66	22		95	24			
SWL 6	19	Residual EFS	22	54	25		102	11			
SWL 6	24	Residual EFS	22	54	25		94	11			
SWL 6	25	Residual EFS	25				102				
SWL 10R	8	Residual EFS	22	73	27	46	105	11			
SWL 10R	14	Residual EFS	22								
SWL 11	1	Residual EFS	24	66	22		94	15			
SWL 11	14	Residual EFS	24				94	15			
SWL 11	19	Residual EFS	30				90	29			
SWL 11	24	Residual EFS	29	66	22		95	24			
SWL 11	25	Residual EFS	27				96	26			
SWL 11R	6	Residual EFS	25	66	25						
SWL 11R	14	Residual EFS	27				95	17			
SWL 11R	19	Residual EFS	28	73	25		92	17			
SWL 11R	24	Residual EFS	32								


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**Laboratory Testing**

- Rock**
  - Water content & Unit weight
  - 133 - Unconfined compression
  - 15 - UU Triaxial
  - 267 - Point Load
  - 39 - Brazilian (indirect)
  - 10 - Slake durability


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**LBJ Geotechnical Workshop**




SUMMARY OF LABORATORY ROCK TESTING RESULTS - FRESH ROCK, PHASE 1  
 I-35 LBJ FREEWAY - WEST SECTION  
 MANAGED HOV LANES TUNNEL PROJECT  
 DALLAS, TEXAS

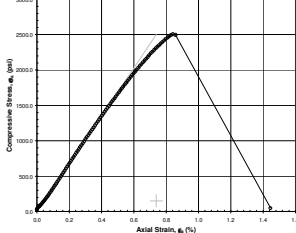
Boring	Depth (ft)	Geology	Moisture Content (%)	Unit Dry Weight (pcf)	Point Load (psi)	Point Load Test Type	Splitting Tensile (psi)	Unconfined Compression (psi)	UU Strength (psi)	Slake Durability Classification
BE 1L1	18.2	Fresh AC	7	127	566	Axial Test				
BE 1L1	38.9	Fresh AC	9	121	334	Diametral Test		2331		
BE 1R	9	Fresh AC	2	119	511	Axial Test			2304	
BE 1R	24	Fresh AC	5	123	383	Axial Test				
BE 1R	41.5	Fresh AC	4	118	310	Diametral Test		2585		
BE 1R	50.5	Fresh AC								
BE 2L	11.5	Fresh AC			537	Axial Test				
BE 2L	12.5	Fresh AC	7	121				2375		
BE 2L	26	Fresh AC	3	120	429	Axial Test		3704		
BE 2L	28	Fresh AC	5	115	560	Diametral Test				
BE 2R	32.8	Fresh AC								
BE 3L	10.4	Fresh AC	3	128	473	Axial Test		2843		
BE 3L	18.3	Fresh AC			508	Diametral Test				
BE 3L	24.2	Fresh AC	2	123	621	Axial Test		3625		
BE 3L	15.5	Fresh AC	3	128	566	Axial Test		2668		
BE 3L	21	Fresh AC	3	125	258	Diametral Test				
BE 3L	25.1	Fresh AC	3	127	636	Axial Test		2728		
BE 6R	13.2	Fresh AC	5	121	563	Axial Test		3421		
BE 6R	18.5	Fresh AC			325	Diametral Test				
BE 6R	29.3	Fresh AC	7	116	557	Axial Test		2548		


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Unconfined Strength = 2,000.46 psi  
 $E_{uc} = 341,074$  psi  
 Failure Strain = 0.84 %  
 Strain Rate = 0.05 in/min  
 Water Content = 6.1 %  
 $\gamma = 155.43$  pcf  
 $\gamma_w = 127.60$  pcf  
 $G = 81.1$  %


$\phi = 1.330$   
 Diameter (D) = 1.38 inch  
 Height (H) = 4.24 inch  
 HD = 0.29  
 $\phi_p = 1.785$   
 Description: LIMESTONE

**UNCONFINED COMPRESSION TEST**  
 Boring: T-6L, Depth: 28 - 28.7 ft.


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**LBJ Geotechnical Workshop**



**Subsurface Conditions**

- Fill**
  - Found throughout, all 93
  - Thickness 0.5 ft to 28 ft (ave. 6ft)
  - Typically clay with sand
  - Crushed limestone, asphalt, concrete
  - Two aborted attempts @ T9L
  - PI ~ 30 %
  - $q_u \sim 38$  psi


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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Alluvium**
    - 20 of 93
    - Thickness 3 ft to 61 ft (avg. 25 ft)
    - Frequent in west
    - Isolated occurrences elsewhere
    - Clay with sand / silt / gravel
    - Sorted gravel discontinuous lenses
    - PI ~ 31 %
    - $q_u \sim 34$  psi



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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Residual**
    - 21 of 93
    - Thickness 2 ft to 23 ft (avg. 11 ft)
    - Typically fat clay
    - Associated with Eagle Ford shale
    - Highly expansive
    - AC EFS
    - PI ~ 31 %, PI ~ 42 %
    - $q_u \sim 19$  psi,  $q_u \sim 19$  psi,



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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Austin Chalk - weathered**
    - Limestone
    - 52 of 93
    - Contact near BW21L
    - Thickness 1 ft to 22 ft (avg. 6.5 ft)
  - Austin Chalk - unweathered**
    - Slightly weathered to fresh
    - 64 of 93
    - Drilled thickness 5 ft to 210 ft (72 ft)
    - Thin seams of bentonite (5" to 10")
    - Marker bed (95'-100' above EFS)
    - Argillaceous (base high)



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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Austin Chalk - weathered**
    - $q_u \sim 600$  psi
    - PL ~ 380 psi
    - PI ~ 24 %
  - Austin Chalk - unweathered**
    - $q_u \sim 2790$  psi
    - Young's ~ 570 ksi
    - Axial PL ~ 480 psi, diametric ~ 300 psi
    - UU ~ 4545 psi
    - Brazilian ~ 250 psi



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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Eagle Ford**
    - Shale (old Clay-Shale)
    - BW21L west below overburden
    - Weathered 25 of 93
    - "Shaly Clay"
    - Drilled thickness 2 ft to 48 ft (19 ft)
    - Fresh 35 of 93
    - Thickness 200 ft to 300 ft
    - Expansive



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## LBJ Geotechnical Workshop

- Subsurface Conditions**
  - Eagle Ford - weathered**
    - $q_u \sim 70$  psi
    - Swell ~ 9 %
    - PI ~ 14 %
  - Eagle Ford - unweathered**
    - $q_u \sim 180$  psi
    - PL ~ 64 psi



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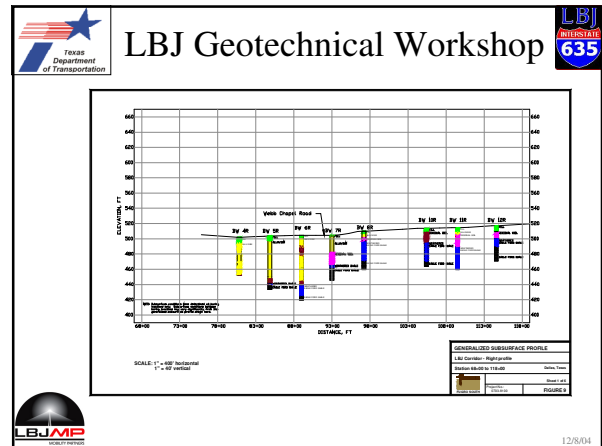
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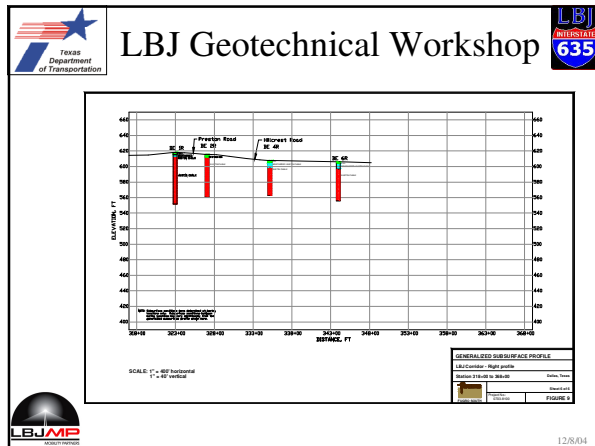
Subsurface Conditions

Groundwater

- Seepage or wet soil 22 of 93
- West box alluvium (2 distinct levels)
- Generally 15 to 30 ft depth
- Fracture flow in weathered AC
- Rare in fresh

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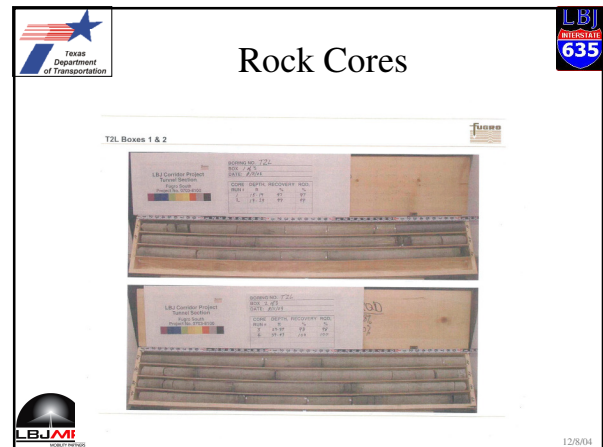


**LBJ Geotechnical Workshop**

- Phase 2**
  - Field Investigation**
    - ~ 44 borings total
    - ~ 37 vertical (fill-in)
    - ~ 7 angle borings
    - ~ Packer tests in fracture zones
    - ~ SPP (7), WWP (8)

**LBJ Geotechnical Workshop**

- Phase 2**
  - Laboratory Testing**
    - similar to Phase 1
    - Cherchar
    - Schmidt Hammer
    - Shore Selscope
    - Taber Abrasion
    - Punch Penetration
    - Thin Section
    - X-ray diffraction





**Mined Tunnel Geotechnical Issues**

- Basic excavation shape and support
- Influence of bentonite beds
- Effect of argillaceous facies of chalk
- Potential near-vertical fractures
- Fault zones – potential impact
- Shear “swarms” – potential impact
- Adequate cover above Eagle Ford Shale


**Phase II Geotechnical Program**



- Fill in gaps in Phase 1 coverage
- Investigate longer/deeper tunnel alternatives
- Further sample/define bentonite marker bed
- Angle borings to:
  - Evaluate potential portal locations
  - Attempt to define fault zones and fractures
- Most borings serve multiple purposes

## Phase II Program


- 40 to 45 borings, approximately 4000 linear ft
- Includes 8 angle borings
- Additional piezometer installation (~10 locations), potential packer testing in fracture zones
- Soil and Rock laboratory tests as per Phase I
- Physical property tests for mechanical excavation prediction
  - Cerchar, punch penetration, Sceleroscope
  - Petrographic, Taber Abrasion, Schmidt Hammer, X-Ray diffraction




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## Geotechnical Data Report


- Supplemental report to be prepared
- Format as per Phase 1 Report


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## Geotechnical Baseline Report

- Will be prepared as Geotechnical Baseline Report for Bidding (GBR-B)
- Will evaluate all previous and new geotechnical information (1998, Phase 1, Phase 2) for histograms, etc.
- Will review rock properties and historical tunnel construction in Austin Formation
- Documents will define approach to Geotechnical Baseline Report for Construction (GBR-C)
- Potential opportunities for CDA Team to request additional exploration/testing


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## West Section Comprehensive Development Agreement (CDA) to...

Develop, Design and Construct and Potentially, Finance, Maintain and Operate the LBJ Freeway West Section Managed Lanes


- Solicit Request for Qualifications (RFQ)
- Short List
- Solicit Request for Detailed Proposals (RFDP)
- Make Best Value Selection




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## West Section Procurement Engineer (PcE) has 3 - Basic Roles

- Procurement of the CDA Team
  - As needed to develop the RFDP requirements
- Preliminary Engineering / Early Design Tasks
  - As needed to define the RFDP for the CDA Team and define/minimize risk for the project
- Project Oversight & Management of the CDA
  - As defined in the RFDP process



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## West Section CDA Project Construction Costs

\$ Millions - 2003



<b>A</b>	West Section Tunnels and Managed Lanes	\$ 530
<b>B</b>	IH 635/ IH 35E Partial Interchange & Direct Connections	\$ 65
<b>C</b>	IH 35E / Loop 12 Direct Connections	\$ 125
<b>Total : (Construction Costs Only)</b>		<b>\$ 720</b>




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## West Section Timeline & Schedule

Issue RFQ for CDA	1st Q 2005
Issue Draft RFP for Industry Review	4 Months
Industry Review and Issuance of Final RFP	4 Months
Prepare CDA Detailed Proposals	4 Months
Complete CDA Selection & Negotiations	4 Months
Execute Contract & Issue Notice to Proceed	Jun <u>2006</u>

## Thank You for Listening

- Questions
- Comments
- Thoughts
- Etc....

